

# The Subsistence Harvest of Pacific Herring Spawn in Sitka Sound, Alaska, 2015

by

Lauren A. Sill

and

Terri Lemons

---

June 2017

---

Alaska Department of Fish and Game

Division of Subsistence



## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the reports by the Division of Subsistence. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly-accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H <sub>A</sub>
gram	g			base of natural logarithm	e
hectare	ha			catch per unit effort	CPUE
kilogram	kg			coefficient of variation	CV
kilometer	km	all commonly-accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	common test statistics (F, t, $\chi^2$ , etc.)	
liter	L			confidence interval	CI
meter	m			correlation coefficient (multiple)	R
milliliter	mL	at	@	correlation coefficient (simple)	r
millimeter	mm	compass directions:		covariance	cov
		east	E	degree (angular)	°
Weights and measures (English)		north	N	degrees of freedom	df
cubic feet per second	ft <sup>3</sup> /s	south	S	expected value	E
foot	ft	west	W	greater than	>
gallon	gal	copyright	©	greater than or equal to	≥
inch	in	corporate suffixes:		harvest per unit effort	HPUE
mile	mi	Company	Co.	less than	<
nautical mile	nmi	Corporation	Corp.	less than or equal to	≤
ounce	oz	Incorporated	Inc.	logarithm (natural)	ln
pound	lb	Limited	Ltd.	logarithm (base 10)	log
quart	qt	District of Columbia	D.C.	logarithm (specify base)	log <sub>2</sub> , etc.
yard	yd	et alii (and others)	et al.	minute (angular)	'
		et cetera (and so forth)	etc.	not significant	NS
Time and temperature		exempli gratia (for example)	e.g.	null hypothesis	H <sub>0</sub>
day	d	Federal Information Code	FIC	percent	%
degrees Celsius	°C	id est (that is)	i.e.	probability	P
degrees Fahrenheit	°F	latitude or longitude	lat. or long.	probability of a type I error (rejection of the null hypothesis when true)	$\alpha$
degrees kelvin	K	monetary symbols (U.S.)	\$, ¢	probability of a type II error (acceptance of the null hypothesis when false)	$\beta$
hour	h	mnths (tables and figures)	first three letters (Jan.,...,Dec)	second (angular)	"
minute	min			standard deviation	SD
second	s	registered trademark	®	standard error	SE
		trademark	™	variance	
Physics and chemistry		United States (adjective)	U.S.	population	Var
<i>all atomic symbols</i>		United States of America (noun)	USA	sample	var
alternating current	AC	U.S.C.	United States Code		
ampere	A	U.S. state	two-letter abbreviations (e.g., AK, WA)		
calorie	cal				
direct current	DC				
hertz	Hz	Measures (fisheries)			
horsepower	hp	fork length	FL		
hydrogen ion activity (negative log of) pH		mid-eye-to-fork	MEF		
parts per million	ppm	mid-eye-to-tail-fork	METF		
parts per thousand	ppt, ‰	standard length	SL		
volts	V	total length	TL		
watts	W				

*TECHNICAL PAPER NO. 428*

THE SUBSISTENCE HARVEST OF PACIFIC HERRING SPAWN IN SITKA  
SOUND, ALASKA, 2015

by

Lauren A. Sill,  
Alaska Department of Fish and Game Division of Subsistence, Douglas

and

Terri Lemons  
Alaska Department of Fish and Game Division of Subsistence, Anchorage

Alaska Department of Fish and Game  
Division of Subsistence  
PO Box 110024  
Juneau, AK 99811

June 2017

The Division of Subsistence Technical Paper series was established in 1979 and represents the most complete collection of information about customary and traditional uses of fish and wildlife resources in Alaska. The papers cover all regions of the state. Some papers were written in response to specific fish and game management issues. Others provide detailed, basic information on the subsistence uses of particular communities which pertain to a large number of scientific and policy questions.

Technical Paper series reports are available through the Alaska Resources Library and Information Services (ARLIS), the Alaska State Library and on the Internet: <http://www.adfg.alaska.gov/sf/publications>. This publication has undergone editorial and professional review.

*Lauren A. Sill*

*Alaska Department of Fish and Game Division of Subsistence  
PO Box 110024, Juneau, AK 99811-0024, USA*

*and*

*Terri Lemons*

*Alaska Department of Fish and Game Division of Subsistence  
333 Raspberry Road, Anchorage, AK 99518-1565, USA*

*This document should be cited as:*

*Sill, L.A. and T. Lemons. 2017. The Subsistence Harvest of Pacific Herring Spawn in Sitka Sound, Alaska, 2015.  
Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 428, Douglas.*

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:

ADF&G ADA Coordinator, P.O. Box 115526, Juneau, AK, 99811-5526

U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042, Arlington, VA, 22203

Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW, MS 5230, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648, (Juneau TDD)

907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:

ADF&G Division of Subsistence at <http://www.adfg.alaska.gov/index.cfm?adfg=contacts.main>.

# TABLE OF CONTENTS

	Page
<b>LIST OF TABLES.....</b>	<b>ii</b>
<b>LIST OF FIGURES.....</b>	<b>ii</b>
<b>LIST OF APPENDICES .....</b>	<b>ii</b>
<b>ABSTRACT .....</b>	<b>iii</b>
<b>1. INTRODUCTION.....</b>	<b>1</b>
Project Objectives.....	2
Methods .....	2
Survey Plan and Implementation .....	2
Development of the Household Survey List .....	3
The Survey Instrument.....	3
Survey Implementation.....	4
Update of the 2015 Conversion Factors.....	4
Data Analysis.....	5
Dissemination of Survey Results.....	7
<b>2. 2015 RESULTS.....</b>	<b>9</b>
Conversion Factors .....	15
Harvest Locations .....	15
<b>3. DISCUSSION .....</b>	<b>17</b>
Changes in Use of Herring Spawn.....	19
Conversion Factors .....	20
Location of Harvests.....	21
Spawn-on-Kelp Fishery .....	21
<b>4. CONCLUSION.....</b>	<b>23</b>
<b>ACKNOWLEDGMENTS.....</b>	<b>24</b>
<b>REFERENCES CITED.....</b>	<b>25</b>

## LIST OF TABLES

Table	Page
1.–Estimated subsistence harvest of herring spawn in Sitka Sound, 1983, 1987, 1996, 2002–2015.....	8
2.–Subsistence harvest and use of herring spawn by community of residence, Sitka area, 2015.....	11
3.–Distribution of subsistence herring spawn harvest, Sitka area, 2015.....	12
4.–Conversion factors for 2010–2015. ....	15
5.–Reported locations of subsistence herring spawn harvest, Sitka Sound, 2015.....	16
6.–Locations where residents reported herring eggs were sourced, Angoon, Haines, Hoonah, Hydaburg, and Whale Pass, 2012. ....	20

## LIST OF FIGURES

Figure	Page
1.–Distribution of subsistence herring spawn harvest by substrate, Sitka area, 2015.....	12
2.–Household perception of herring spawn harvest and use compared to previous years, Sitka area, 2015. ....	13
3.–Percentage of total Sitka Sound subsistence harvested herring spawn that was shared, 2015.....	13
4.–Reported reasons households did not attempt to harvest herring spawn, Sitka area, 2015. ....	14
5.–Reasons given for why household harvests were different, either less or more, in 2015 than in recent years, Sitka Sound harvesters, 2015. ....	14
6.–Reported harvest locations, 2015.....	16
7.–Total pounds usable weight of herring spawn harvested, number of harvesting households, and amount reasonably necessary for subsistence (ANS) of herring spawn on all substrates in Sitka Sound, 2002– 2015.....	19
8.–Percentage of households using, receiving, giving, and harvesting herring eggs, Hydaburg, Hoonah, Haines, and Angoon, 2012; and Sitka, 2013. ....	20

## LIST OF APPENDICES

Appendix	Page
A: Map of Area of Sitka Sound Closed to Commercial Herring Sac Roe Fishing .....	27
B: Sitka Sound Subsistence Herring Egg Harvest Survey, 2015 .....	29
C: 2015 Code Book .....	34

## ABSTRACT

The subsistence fishery for the spawn of Pacific herring *Clupea pallasii* in Sitka Sound was historically, and remains, important to Alaska residents. Alaska Department of Fish and Game (ADF&G) Division of Subsistence research on this contemporary subsistence fishery reveals that harvesting herring spawn is a specialized activity in which a relatively small number of Southeast Alaska residents harvest and distribute herring spawn widely. Annual subsistence harvest monitoring surveys began in 2002 in response to concerns from subsistence harvesters that the commercial sac roe herring fishery was negatively affecting subsistence harvesting success. This report presents the results of the 14th annual harvest survey conducted in Sitka and neighboring communities in 2015. The survey generated data used to calculate estimates of the subsistence harvest of herring spawn on various substrates, including hemlock branches, kelp, and other seaweed in Sitka Sound. An estimated total of 106,998 lb of herring spawn was harvested in 2015. Approximately 95% of the harvest was shared with other households within Sitka as well as other communities in the state and beyond.

Key words: Pacific herring, *Clupea pallasii*, herring spawn, subsistence fishing, harvest estimate, subsistence, Sitka, Sitka Tribe of Alaska





# 1. INTRODUCTION

The spawn of Pacific herring *Clupea pallasii*, generally known as “herring eggs,” is a traditional food of great cultural importance for indigenous coastal communities throughout the Pacific Northwest and Southeast Alaska. Although herring spawn is consumed throughout this region, only a small number of people have the time, equipment, skills, and knowledge required to harvest it. This report presents findings of the 14th annual harvest assessment, which occurred in the spring of 2015, designed to document subsistence harvests of herring spawn in Sitka Sound (see Holen et al. 2011; Sill and Lemons 2012, 2014a–b, 2015, for discussion of the previous study years).

Herring return annually to Sitka Sound in numbers that are not seen elsewhere in Southeast Alaska. The sheer abundance of herring and herring spawn, and the length of the spawning period, has set Sitka Sound apart from other areas in Alaska and the Pacific Northwest (Schroeder and Kookesh 1990). Herring harvesters have taken advantage of this unique harvest opportunity during both historical and contemporary periods (Schroeder and Kookesh 1990). In the 19th century, Sitka was a center for Tlingit from all over Southeast Alaska to harvest herring and herring spawn (Emmons 1991; Pierce 1972). In the 1860s, herring were so numerous around Sitka in February and March that the water became milky from eggs and milt and it was easy to catch herring with a rake (Tikhmenev 1978). Herring spawn was traditionally exchanged for specialized foods, such as eulachon *Thaleichthys pacificus* oil and dried eulachon, berries, dried seaweed, and mountain goat *Oreamnos americanus* meat. It was also traded for raw materials and handicrafts. Recently, herring eggs from Sitka Sound have been documented as being shared throughout Southeast Alaska and beyond to as far north as Utqiagvik (formerly Barrow) and Point Hope and as far south as Seattle (Sill and Lemons 2012).

The primary method of the contemporary harvest is to submerge branches of the Western hemlock *Tsuga heterophylla* in salt waters just outside the intertidal zone before spawning takes place. Herring spawn is also collected on other substrates such as *Macrocystis* kelp, hair seaweed *Desmarestia* spp., and rockweed *Fucus* spp. (Schroeder and Kookesh 1990). The herring deposit their eggs on the branches of the hemlock or other substrate that are then removed from the water. Historically, herring spawn was consumed either fresh or air-dried, or was packed in salt for later use and distribution. As freezers became more common in households in the 1940s and 1950s, freezing became the preferred method of preserving herring spawn.

At its February 1989 meeting, the Alaska Board of Fisheries (BOF) made a positive customary and traditional use determination for the harvest of herring spawn in Sitka Sound. In September 2001, the Sitka Tribe of Alaska (STA) met with representatives from the Alaska Department of Fish and Game (ADF&G) to discuss tribal members’ difficulty in meeting their subsistence needs for herring spawn in Sitka Sound during the spring 2001 season. They cited the intensive commercial harvest of herring in the sac roe fishery in the Middle, Crow, and Kasiana islands areas as affecting the subsistence users’ ability to successfully harvest herring spawn on hemlock branches.

At the January 2002 BOF meeting, STA submitted an unsuccessful proposal requesting recognition of the geographically and historically important areas used for the subsistence herring spawn harvest. During this meeting the BOF also considered, but did not adopt, a permit program for the subsistence fishery. As a consequence of these proposals, the BOF requested that the ADF&G Division of Subsistence work with STA to develop a harvest monitoring program based on in-person harvest surveys. This method of data collection provides a way to increase community buy-in and participation, build capacity within the community and STA, and provide consistent data. The BOF also made a determination that the amount reasonably necessary for subsistence<sup>1</sup> (ANS) was between 105,000 and 158,000 lb of herring spawn harvested from Section 13A and that portion of Section 13B that is north of the latitude of Aspid Cape

---

1. Pursuant to Alaska Statute 16.05.258, the Alaska Board of Fisheries and the Alaska Board of Game are charged with identifying the fish stocks and game populations that are customarily and traditionally taken or used for subsistence, and with determining the amount of the harvestable portion that is reasonably necessary for subsistence uses.

(5 AAC 01.716 (b)). This finding was based upon the best harvest estimates of ADF&G, including results from a 1996 household harvest survey and a 1989 harvest estimate. At its 2009 meeting, the BOF revised the ANS to 136,000–227,000 lb, based on the mean estimated harvest from 2002–2008, as determined through the annual herring spawn harvest survey conducted by ADF&G and STA (Holen et al. 2011). In the Sitka Sound area, state regulations allow the subsistence harvest of herring and herring spawn in sections 13A and 13B north of Aspid Cape on Baranof Island (5 AAC 01.716 (a) (7)) as well as the limited noncommercial exchange of subsistence-harvested herring spawn on kelp for customary trade (5 AAC 01.717). In 2012, STA submitted a proposal to close to commercial fishing an area of Sitka Sound that has historically been used for the subsistence harvest of herring spawn. A compromise version of the proposal was adopted by the BOF, resulting in approximately 10 square miles of Sitka Sound being closed to the commercial herring sac roe fishery (see Appendix A).

Monitoring the subsistence harvest of herring spawn in Sitka Sound is an ongoing project. ADF&G participation in the annual harvest monitoring program is partially supported by a reimbursable services agreement (RSA) from the Division of Commercial Fisheries to the Division of Subsistence as well as by the Division of Subsistence general funds. STA provides its own funding for the project and is also supported by a cooperative agreement with ADF&G. STA and ADF&G collaborate on survey design and data collection. ADF&G provides technical consultation and, when possible, field survey and interviewing support for the project and STA provides ADF&G with completed surveys.

## PROJECT OBJECTIVES

The goal of the harvest monitoring program is to annually document the subsistence harvest of herring spawn through household surveys with all harvesters who participate in the fishery in Sitka Sound. The objectives of the project in 2015 were to:

1. Conduct in-person interviews with household members in Sitka and surrounding communities who were identified as likely harvesters of herring spawn from Sitka Sound for subsistence;
2. Produce estimates of the total pounds of herring spawn harvested on hemlock branches, giant kelp *Macrocystis pyrifera*, hair seaweed *Desmarestia spp.*, and “other” substrates; and
3. Identify locations where herring spawn were harvested.

## METHODS

Estimates of the subsistence herring spawn harvest in Sitka Sound have been produced for 2002–2015 by systematically identifying and surveying households that harvest herring spawn. This annual project is guided by the research principles outlined in the *Alaska Federation of Natives Guidelines for Research*<sup>2</sup> and by the National Science Foundation, Office of Polar Programs in its *Principles for the Conduct of Research in the Arctic*<sup>3</sup>, as well as the Alaska confidentiality statute (AS 16.05.815). These principles stress community approval of research designs, informed consent, anonymity of study participants, community review of draft study findings, and the provision of study findings to each study community upon completion of the research.

## Survey Plan and Implementation

STA and ADF&G met in February and March prior to the start of the 2015 subsistence herring spawn harvest to review the survey instrument, the methods for compiling the household list, and the methods for creating and validating conversion factors. The methods outlined in this section are a collaborative

---

2. Alaska Federation of Natives. 2013. *Alaska Federation of Natives Guidelines for Research*. Alaska Native Knowledge Network. Accessed January 5, 2017. <http://www.ankn.uaf.edu/IKS/afnguide.html>

3. National Science Foundation Interagency Social Science Task Force. 2012. *Principles for the Conduct of Research in the Arctic*. Accessed January 5, 2017. <http://www.nsf.gov/od/opp/arctic/conduct.jsp>

effort between ADF&G and STA. Division staff participated in the herring spawn harvest in Sitka during April 2015 and collaborated with STA staff in updating the weight conversion factors. STA staff conducted most of the household surveys; ADF&G staff were present in Sitka at the beginning of the survey effort and assisted with approximately one-half of the household surveys administered during this time.

## **Development of the Household Survey List**

To meet Objective 1, STA updated the list of known and likely harvesters for the 2015 season. Using the 2014 household list as a starting point, new harvesters were added and non-harvesters were removed, following the methods discussed below and in more detail in Holen et al. (2011). Outreach by STA and a chain referral method were employed to expand the list. Harvesting is a highly visible activity; therefore it was assumed that active harvesters would be aware of other harvesters. Based on the knowledge of active harvesters identified through STA outreach efforts, additional potential harvesting households were added to the household list. The household list also included households from other communities who harvested herring spawn in Sitka Sound as identified through STA outreach efforts and knowledge of the surveyors and STA staff.

For this annual survey program, once added to the household list, an identified household remains on the list unless 1 of 3 situations occurs:

1. If the household is surveyed for 3 consecutive years and has not attempted to harvest within that time, it is removed, even if the household answers in the affirmative as to whether they plan to harvest in the future; or
2. If a household is unable to be contacted for 3 consecutive years, it is removed from the list; or
3. If the household identifies that it no longer plans to harvest, it is removed from the list.

Once removed from the list, the household identification (ID) number is retired. Prior to the beginning of the 2015 herring spawn event, staff from STA and ADF&G reviewed the household master list to ensure these parameters were satisfied.

## **The Survey Instrument**

Objectives 2 and 3 were addressed through the use of a household survey. The survey instrument was designed to collect information about:

1. Whether respondents harvested, attempted to harvest, used, received, or gave away herring spawn.
2. The amount of herring spawn harvested.
3. The kind of substrate used.
4. Whether respondents harvested on their own or in collaboration with other households.
5. The amount of herring spawn respondents kept for their own use, gave away locally, or shipped out of Sitka, and the communities with which they shared the harvest.
6. The location of respondents' harvests.
7. Survey respondents' qualitative assessments of the study year's herring spawn harvest.
8. Survey respondents' qualitative descriptions of their participation in the harvest.

The 2015 survey instrument was similar to the 2014 instrument. Dr. Tom Thornton and Dr. Shingo Hamada partnered with ADF&G and STA so that questions concerning the barter and trade of herring eggs could be added to the survey form to avoid duplication of survey efforts. The results of this component of the survey will be reported in a publication by Dr. Thornton and Dr. Hamada and are not

summarized in this report. A copy of the 2015 instrument can be found in Appendix B. Harvest location information was collected through 2 methods. One method was for the respondent to simply pick among standard generalized locations offered on the survey (see Appendix B). The other method was using an application designed on the ArcGIS Runtime SDK for iOS platform; basically a mapping data collection application for the Apple iPad.<sup>4</sup> The point, polygon, or line was drawn on a U.S. Geological Survey topographic relief map downloaded on the iPad. The iPad allowed the user to zoom in and out to the appropriate scale and to document harvesting activities wherever they occurred. Once a feature was accepted, an attribute box was filled out by the researcher that noted the species harvested, amount, method of access to the resource, and month of harvest. The data were uploaded via Wi-Fi to a server. Once data collection was complete the data were downloaded into an ArcGIS file geodatabase. The application was developed by HDR, Inc.

## **Survey Implementation**

Using the 2014 household list as a base, STA created a list of 79 potential harvesting households for 2015. An interview was attempted for each household on the list; 58 households were successfully interviewed, 20 households were unable to be contacted, and one household declined to participate. ADF&G Subsistence Resource Specialist Rosalie Grant and STA Fisheries Biologist Jessica Gill conducted the surveys in April, May, and June 2015 directly after the herring spawn events. After the final survey effort was finished, completed surveys were sent to ADF&G for coding and analysis. Completed surveys were given a code (see Appendix C for code book) based on user status: 1) individual harvester, 2) non-harvester, or 3) community-harvest boat. The latter code encompasses boats, such as STA's traditional foods boat or the Southeast Alaska Herring Conservation Alliance-sponsored vessel, that harvest herring for community-wide distribution in Sitka or another Southeast Alaska community. These community boats are considered a "household" for the purposes of this report, and are part of the 58 households interviewed. As will be seen in the data analysis section, they are treated slightly differently during analysis. For survey methods, the skipper or owner of the boat is surveyed about the entire harvest brought in by that boat. Crew on board who take home any of the boat's harvest are not considered harvesting households but as receivers of herring spawn.

## **Update of the 2015 Conversion Factors**

Prior to beginning the household survey, conversion factors to estimate the weight of herring spawn in common storage containers were created following the methods established in 2010. From March 30 through April 3, 2015, division staff worked with STA staff to process 7,105 lb of their harvest of herring spawn on hemlock branches to create conversion factors. This was the first harvest of the season for STA and was conducted using a boat owned and operated by STA. Prior to the beginning of the spawn, STA staff set hemlock branches in Sitka Sound. The locations of the sets were determined by STA staff based on active spawning conditions, their knowledge of herring spawn events, and their experience with the harvest.

Based on the plan devised by STA and ADF&G, the following steps were taken to measure weights in the field in 2015.

1. STA staff and ADF&G researchers checked all herring sets and pulled those that were ready.
2. Once the boat returned to the harbor after pulling a set, STA staff used a hanging scale connected to a hydraulic hoist attached to the dock to weigh the branches and remove them from the boat. While still on the deck of the boat, some of the branches were placed in a plastic fish tote of the type commonly used in commercial fisheries. Once full, the tote was lifted off the boat and

---

4. Product names are given because they are established standards for the State of Alaska or for scientific completeness; they do not constitute product endorsement.

weighed. Some branches were not placed in totes; these branches were tied up with rope, then weighed and removed from the boat.

3. STA staff loaded the branches into a pickup truck for transfer to the processing site located in front of the STA Resources Protection Department office. The method of processing spawn depended on how the final product was to be stored. For storage in boxes or grocery bags, processors used pruning shears to remove the larger branches (usually anything larger than approximately one-half-inch in diameter) and the poorly covered branches. For storage in gallon-sized bags, the more rigid branches were discarded, leaving only the pliable branches and needles that would not tear the bags.
4. The processed spawn was placed in containers identified by STA as common containers used to store, move, and ship herring spawn. The container types reflected the units harvesters might be familiar with and able to report rather than having to estimate total pounds harvested for the survey. STA and division researchers identified 25 lb, 50 lb, and 80 lb wetlock boxes—a type of waxed cardboard box commonly used for shipping seafood—as well as plastic zip-top gallon-sized bags as the most common container types for herring spawn on hemlock branches and on kelp.
  - a. Each wetlock box from a herring set was placed in a plastic tote and weighed from a hanging scale. The gross weight of each tote was recorded by hand (weight of the plastic tote plus the weight of the wetlock box plus the weight of the spawn).
  - b. Weights were taken for each box of processed spawn in order to understand variability between boxes. An average weight of each type of box was established. The net weights of all boxes of spawn coming from the original unprocessed set were compared to understand the difference between the unprocessed and processed spawn.
5. A few wetlock boxes from each set were taken into the STA offices and further processed for gallon-sized zip-top plastic bags. Weights of filled bags were measured by a desktop analog scale and recorded by hand.
  - a. The weights of all zip-top bags coming from one wetlock box of spawn were compared to the weight of the wetlock box to understand the effect of additional processing.
  - b. The weights of the bags were also taken independently for the purpose of developing an average weight of a bag filled with processed spawn.
  - c. During the processing, some of the plastic bags did not get filled to the 100% mark. These bags were included in the total weight calculations, but not included in mean bag weight calculations.

In all, 22 sets of branches were placed by STA staff in herring spawning areas and 8 of these sets were harvested for a total STA harvest of 9,410 lb of herring spawn in 2015. The first 6 sets were weighed and processed for the conversion factor. The other 2 sets were harvested at a later date and not used in the conversion factor update.

## **DATA ANALYSIS**

ADF&G Information Management staff analyzed the data from the 2015 survey to produce estimates of the total harvest of herring spawn on all substrates. For 2015, the surveys were coded for data entry by ADF&G staff in Douglas using the conversion factors that were determined as described above. ADF&G staff also created codes for responses given to assessment questions (see Appendix C for 2015 code book). Responses were coded following standardized conventions used by ADF&G. ADF&G Information Management staff in Anchorage set up database structures within a Microsoft SQL Server database. The database structures included rules, constraints, and referential integrity to ensure that data were entered

completely and accurately. Data entry screens were developed in Microsoft Access and made available on a secure network. Daily incremental backups of the database occurred, and transaction logs were backed up hourly. Full backups of the database occurred twice weekly. This ensured that no more than 1 hour of data entry would be lost in the unlikely event of a catastrophic failure. All survey data were entered twice and reviewed so as to minimize data entry errors.

Once data were entered and quality-control checked using standardized procedures employed by ADF&G Information Management staff, the information was processed using the Statistical Package for the Social Sciences (SPSS), Version 21. Initial processing included performing standardized logic checks of the data, which are often needed in complex datasets where rules, constraints, and referential integrity do not capture all the possible inconsistencies that may appear.

Data analysis also included review of raw data frequencies, cross tabulations, table generation, estimation of population parameters, and calculation of confidence intervals for the estimates. Missing information was dealt with in a manner appropriate to each situation, following such standardized practices as minimal value substitution or the use of an average response for similarly-characterized households (mean replacement). Typically, missing data are an uncommon, randomly-occurring phenomenon in ADF&G household surveys. In unusual cases, where a substantial amount of survey information is missing, the household survey is treated as a “non-response” and not included in community estimates. All adjustments were documented.

ADF&G applied the weighted means method (Cochran 1977) to generate harvest estimates for herring spawn from an interviewed sample of households drawn from a list of households known to harvest herring spawn in Sitka during the study year. In cases where a household was known to be an active harvester during one year, but the harvest was unknown that year, the mean household harvest of that year was used as an estimate of that household’s actual harvest. Information Management staff used the following formula to generate these estimates:

$$H = N \left( \frac{\sum x}{n} \right) \quad (1)$$

Where

$H$  = Total estimated harvest,

$N$  = Total number of households identified,

$n$  = Number of sampled households, and

$x$  = household’s reported harvest.

In this approach, the mean of the estimate remains the same as the sampled mean so percentages derived from sampled households can be applied to the entire household list. The principal assumption is that the group of households from the household list of likely harvesters that were unable to be surveyed in 2015 has (on average) the same harvest and use patterns as the households that were successfully contacted. Since the mean is the primary statistic used to develop the estimates, Information Management staff produced a 95% confidence interval (CI), represented as a percentage, to measure the relative precision of the mean. The CI can also be applied to the total estimated harvest to obtain a likely upper and lower range for the estimate. The following formula was applied to create the CI percentage:

$$CI\% = \frac{t_{\alpha/2} \times \frac{s}{\sqrt{n}} \times \sqrt{1 - \frac{n}{N}}}{\bar{x}} \quad (2)$$

Where

$s$  = sample standard deviation,

$n$  = sampled households,

$N$  = total households identified,

$t_{\alpha/2}$  = student's  $t$  statistic for alpha level ( $\alpha = 0.05$ ) with  $n-1$  degrees of freedom, and

$\bar{x}$  = mean harvest.

A small CI percentage indicates low variance in household harvest amounts and that the actual mean is very close to the sampled mean. A larger CI percentage would indicate that there is a larger variance between household harvest amounts and an increased likelihood that the actual mean differs, possibly substantially, from the sampled harvest mean. Confidence intervals for household surveys conducted in 1987 and 1996 as well as data from the annual monitoring program are presented in Table 1. Confidence intervals are not available for the 1983 harvest estimates (Table 1).

## **DISSEMINATION OF SURVEY RESULTS**

Each year the data are presented at the Southeast Alaska sac roe herring preseason meeting held in Sitka in February. In addition, results are presented at a preseason meeting held by STA. In 2015, preliminary results were not available prior to these meetings and were not presented. The written report is reviewed within ADF&G as well as by the Southeast Alaska Herring Conservation Alliance and STA. The final report, once published, is available on the ADF&G website. Hard copies are distributed to STA.

Table 1.—Estimated subsistence harvest of herring spawn in Sitka Sound, 1983, 1987, 1996, 2002–2015.

Year	Percentages based on surveyed households					Estimated values					
	Total number of surveyed households	Percentage of households attempting to harvest	Percentage of households harvesting	Percentage of harvesting households giving away herring spawn	Percentage of harvesting households receiving herring spawn	Estimated number of households attempting to harvest	Estimated number of households harvesting	Estimated harvest, all substrates, pounds	95% confidence interval (± %)	Range: low	Range: high
<i>For the following 3 years, the data pertain to the entire population of Sitka, based on a random sample.</i>											
1983	139	n/a	24.0%	n/a	n/a	n/a	586	42,000 <sup>a</sup>	n/a	n/a	n/a
1987	296	n/a	9.0%	n/a	n/a	n/a	261	20,494 <sup>a</sup>	91%	1,755	39,235
1996	150	16.0%	15.0%	n/a	20.0%	476	464	127,174	72%	35,131	219,217
<i>For the following 9 years, the data pertain to only those Sitka households identified as potential participants in the subsistence herring spawn fishery.</i>											
2002	86	n/a	71.0%	95.0%	40.0%	n/a	77	151,717	23%	116,701	186,734
2003	118	72.0%	71.0%	88.0%	30.0%	117	116	278,799	19%	225,704	331,895
2004	144	61.0%	60.0%	93.0%	17.0%	120	118	381,226	18%	312,224	450,229
2005	159	61.0%	52.0%	82.0%	13.0%	111	95	79,064	9%	72,272	85,856
2006	127	58.0%	55.0%	91.0%	27.0%	93	88	219,356	20%	176,484	262,228
2007	126	55.0%	48.0%	89.0%	43.0%	92	81	87,211	22%	67,702	106,720
2008	128	45.0%	41.0%	73.0%	52.0%	59	54	71,936	6%	67,764	76,108
2009	150	48.0%	48.0%	89.0%	79.0%	91	91	213,712	9%	193,623	233,801
2010	132	30.0%	30.0%	85.0%	12.5%	40	40	154,620	10%	139,872	169,367
2011	109	38.5%	35.4%	94.0%	35.0%	57	53	83,443	5%	79,719	87,166
2012	75	45.0%	43.2%	84.0%	88.0%	50	47	115,799	12%	102,332	129,265
2013	59	64.4%	62.7%	86.1%	27.7%	52	50	78,090	10%	70,075	86,106
2014	60	68.3%	67.8%	87.5%	31.7%	68	68	154,412	13%	135,054	173,769
2015	58	67.2%	65.5%	56.9%	17.2%	52	51	106,998	21%	84,664	129,333

Sources CSIS; Brock and Turek 2007; Sitka Tribe of Alaska household surveys, as summarized in Gmelch and Gmelch 1985.

Note “n/a” indicates data were not collected during the study year.

a. Harvest estimates for 1983 and 1987 are likely low due to the small size of the random sample, which might have failed to include high harvesting households that specialize in harvesting herring spawn.



## 2. 2015 RESULTS

All 3 project objectives were satisfied in 2015. Fifty-eight of 79 households identified as potential harvesters of herring spawn were interviewed, including the STA boat, a boat sponsored by the Southeast Herring Conservation Alliance (SHCA), and 3 other community harvester boats. As reported in Table 1, an estimated 52 households attempted to harvest herring spawn and 51 were successful. This number of harvesters is similar to the 2012 and 2013 harvest years, but is a decrease from estimated harvesters in 2014.

The second objective of the project was to estimate the total subsistence harvest of herring spawn in Sitka Sound during 2015. Table 2 presents the total estimated harvest (106,998 lb) of herring spawn by harvester type and substrate for all of Sitka Sound. As has been seen in prior years of study, the vast majority of harvesters were Sitka residents, but approximately 63% of the herring spawn was harvested by the community harvester boats (including the STA and SHCA boats). These are boats that come to Sitka Sound and harvest large quantities of spawn for general distribution within Sitka or the boats' home communities. In 2015, these boats came from, at a minimum, Hoonah and Angoon; an additional boat was sponsored by SHCA and the STA Traditional Foods program also harvested for the community. Regardless of who harvested the spawn, by far the most commonly used substrate for the harvest was hemlock branches (Figure 1). Ninety-eight percent (104,520 lb) of estimated harvests occurred on hemlock branches, while 2% (2,351 lb) was herring spawn-on-kelp, or spawn harvested on hair seaweed (127 lb) (Figure 1; Table 3). The 2015 spawn-on-kelp harvest amount was similar to what has been documented in years past. In addition to reporting harvest amounts by substrate, respondents were also asked if their use was the same as, less than, or more than their use in recent years. A similar question asked specifically about the harvest of herring eggs, not just the use of them. Approximately 40% of the respondents reported using about the same amount of herring eggs as recent years, with slightly more respondents reporting less use (33%) than more use (24%). In contrast, approximately 23% of respondents felt they harvested the same amount as recent years, while nearly equal percentages of respondents reported harvesting less (37%) or more (40%) (Figure 2).

The majority of the 2015 harvest was shared with the community of Sitka and beyond; this is a documented characteristic of the harvest common to every year of the project. Of the surveyed households that harvested herring spawn in 2015, 57% shared at least some of their harvest (Table 1). Because this survey only attempted to interview harvesters of herring spawn, it is not possible to obtain data for overall community use and sharing of herring spawn. However, household surveys in Sitka and other communities have shown households further share received resources. Of the total estimated amount of herring spawn that was harvested, only 6% was kept for use by the harvesting household; the remainder was given away—54% remaining in Sitka and 40% shipped outside of Sitka (Figure 3; Table 3). Spawn on hemlock branches composed most of the harvest, by weight (85%), kept for the harvester's personal use, but that is largely a factor of the overall higher harvest amounts of spawn harvested on branches. The majority of the spawn-on-branches harvest was shared, with only about 5% kept for personal use (Table 3). In contrast, 35% of all the spawn on kelp harvested and 53% of the spawn on hair seaweed was kept for personal use; the rest was shared (Table 3). In 2015, herring spawn from Sitka Sound was shared with residents of the following communities in addition to Sitka: Anchorage, Angoon, Utqiagvik (Barrow), Bethel, Craig, Dillingham, Dutch Harbor, Haines, Hoonah, Hydaburg, Juneau, Kake, Ketchikan, King Cove, Klawock, Metlakatla, Petersburg, Saint Mary's, Tuntutuliak, and Yakutat, as well as communities outside of Alaska including locations in Washington, California, Oregon, Montana, and Whitehorse, YT. In addition, as noted above, boats from Angoon and Hoonah traveled to Sitka Sound to harvest herring spawn for those communities' residents.

Not all potential harvesters contacted for this survey attempted to harvest herring spawn in 2015. The most common reasons given for not attempting to harvest were that the respondent "received from others" or was "working during the harvest." Conflicts with a work schedule and sharing from others have

consistently been some of the most common reasons given for not participating in the harvest. Other reasons given in 2015 were “transportation” and “personal/health reasons” (Figure 4). Transportation includes lack of a boat, a broken motor or other equipment, or too-high fuel costs. Interestingly, no respondent said they did not harvest because they were not ready for the spawn or it happened too quickly, an answer that has been given most previous years. Of those harvesters who responded that they harvested less or more in 2015 than in previous years (Figure 2), nearly 30% felt they did so because the quality of the eggs was good (Figure 5). Fifteen percent of respondents said they spent more or less effort on harvesting in 2015, and 10% felt that the resource availability differed in 2015, being either more or less.

Table 2.—Subsistence harvest and use of herring spawn by community of residence, Sitka area, 2015.

Resource	Percentage of households					Estimated pounds harvested	Confidence interval		
	Used	Attempted	Harvested	Gave	Received	Total	CI %	Low	High
<i>Sitka Households (n=53)</i>									
Herring spawn on hemlock branches	60.4%	54.7%	52.8%	50.9%	17.0%	36,897.7	13.1%	32,056.6	41,738.8
Herring spawn on kelp	26.4%	24.5%	24.5%	18.9%	5.7%	2,090.7	16.2%	1,751.5	2,429.9
Herring spawn on hair seaweed	11.3%	13.2%	9.4%	5.7%	1.9%	127.0	26.9%	92.9	161.1
<b>Subtotal, herring spawn, all types</b>	<b>69.8%</b>	<b>66.0%</b>	<b>64.2%</b>	<b>54.7%</b>	<b>18.9%</b>	<b>39,115.4</b>	<b>12.7%</b>	<b>34,144.3</b>	<b>44,086.4</b>
<i>Community Harvester Boats (n=5)</i>									
Herring spawn on hemlock branches	80.0%	80.0%	80.0%	80.0%	0.0%	67,622.4	7.2%	62,735.6	72,509.2
Herring spawn on kelp	20.0%	20.0%	20.0%	20.0%	0.0%	260.4	15.1%	221.0	299.8
Herring spawn on hair seaweed	0.0%	20.0%	0.0%	0.0%	0.0%	0.0	NA	NA	NA
<b>Subtotal, herring spawn, all types</b>	<b>80.0%</b>	<b>80.0%</b>	<b>80.0%</b>	<b>80.0%</b>	<b>0.0%</b>	<b>67,882.8</b>	<b>7.2%</b>	<b>62,999.2</b>	<b>72,766.4</b>
<b>Total</b>	<b>70.7%</b>	<b>67.2%</b>	<b>65.5%</b>	<b>56.9%</b>	<b>17.2%</b>	<b>106,998.2</b>	<b>20.9%</b>	<b>84,663.8</b>	<b>129,332.6</b>

Source Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2015.

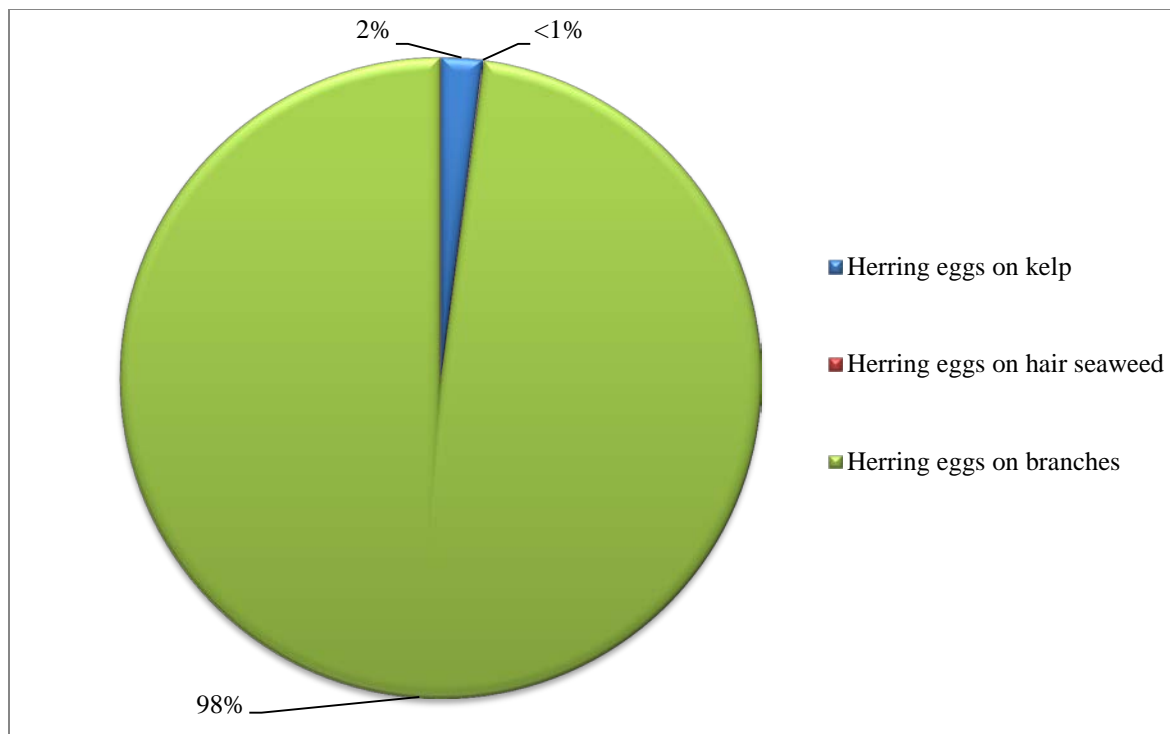


Figure 1.—Distribution of subsistence herring spawn harvest by substrate, Sitka area, 2015.

Table 3.—Distribution of subsistence herring spawn harvest, Sitka area, 2015.

Resource	Estimated harvest						Total pounds
	Kept for own use		Shared within Sitka		Shared outside of Sitka		
	Percentage						
	Pounds	of total harvest	Pounds	Percentage	Pounds	Percentage	
Herring spawn on kelp	824	35.0%	791	33.6%	736	31.3%	2,351
Herring spawn, hair seaweed	68	53.3%	59	46.7%	0	0.0%	127
Herring spawn on hemlock branches	5,113	4.9%	58,215	55.7%	41,193	39.4%	104,520
<b>Herring spawn, all types</b>	<b>6,004</b>	<b>5.6%</b>	<b>50,859</b>	<b>53.8%</b>	<b>37,875</b>	<b>40.1%</b>	<b>106,998</b>

Source Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2015.

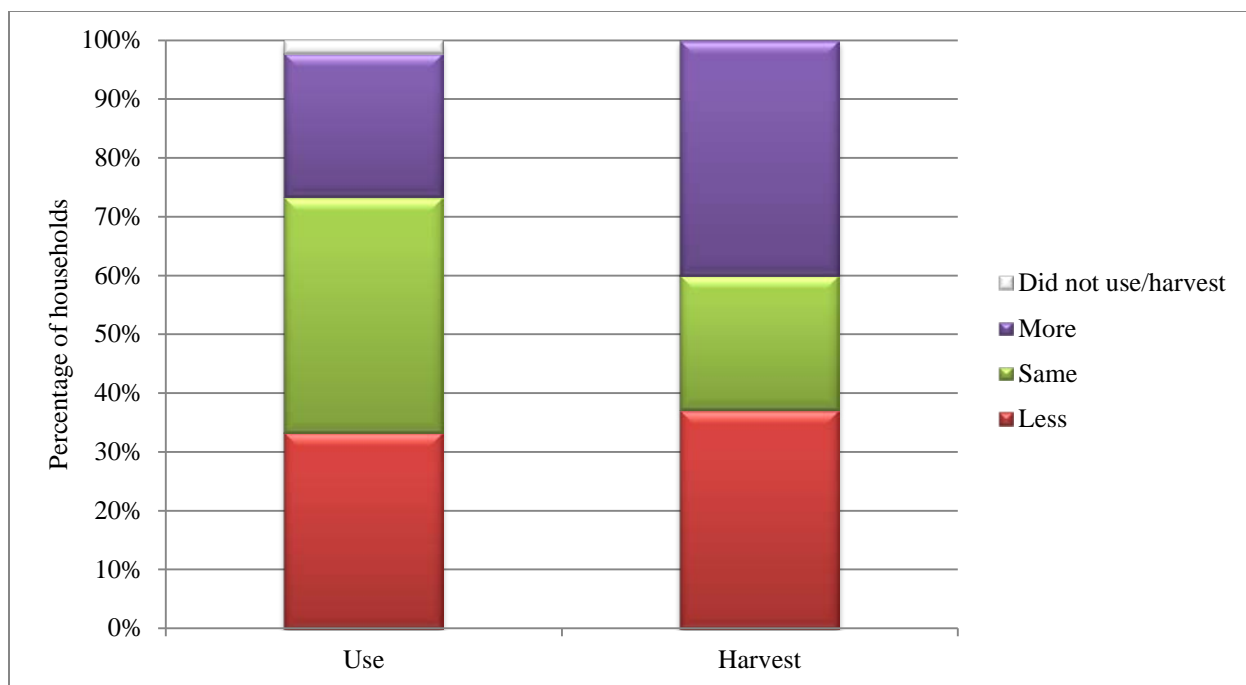


Figure 2.—Household perception of herring spawn harvest and use compared to previous years, Sitka area, 2015.

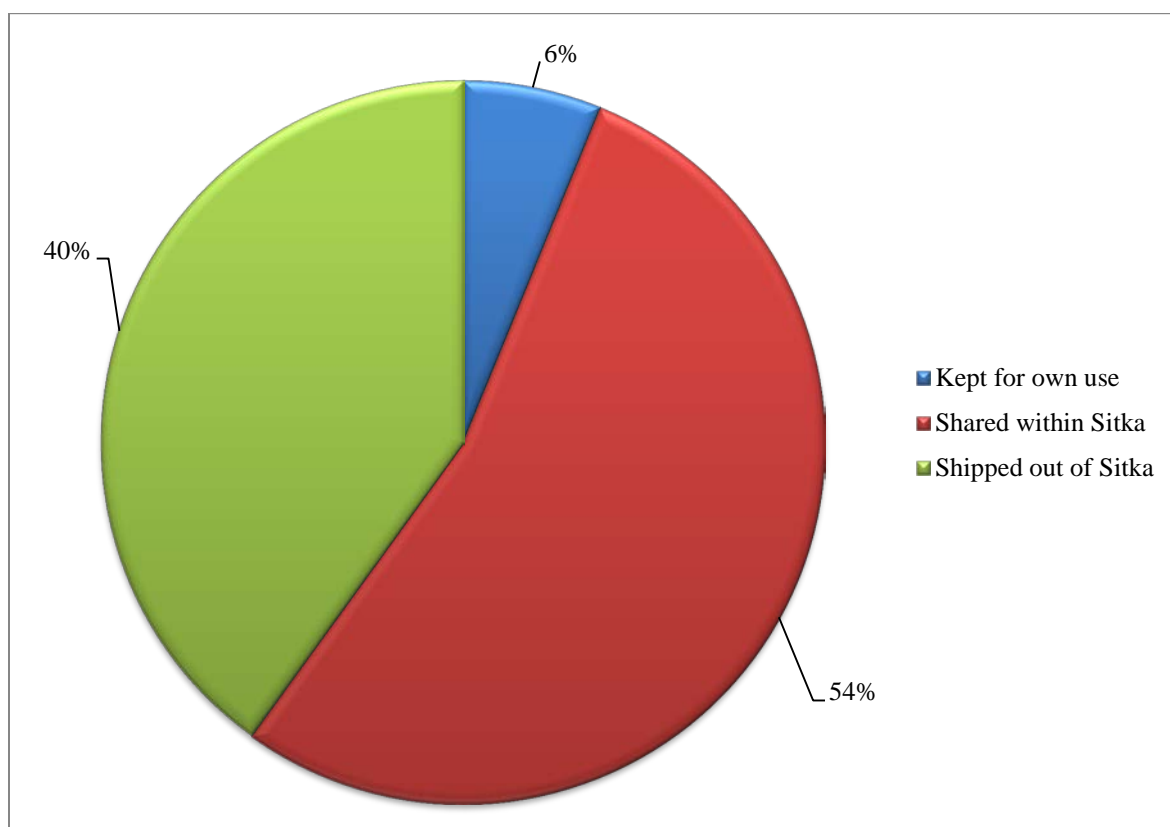


Figure 3.—Percentage of total Sitka Sound subsistence harvested herring spawn that was shared, 2015.

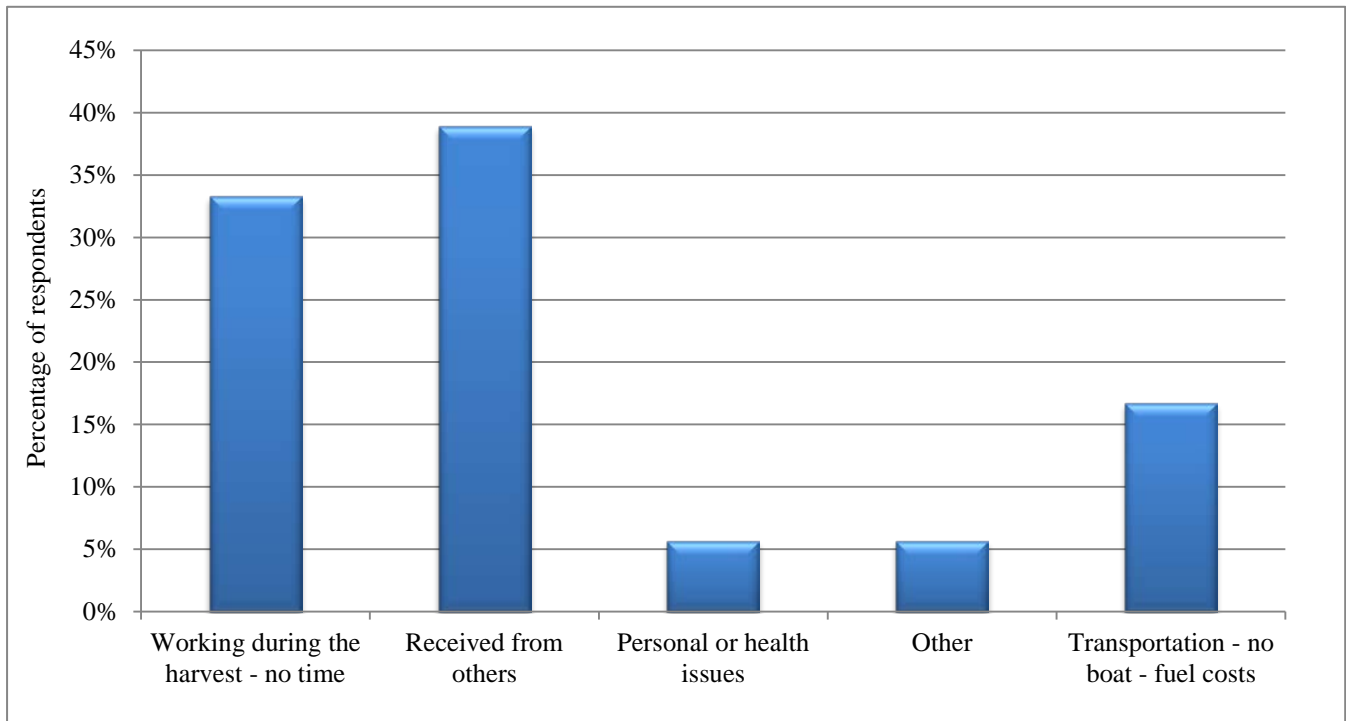


Figure 4.—Reported reasons households did not attempt to harvest herring spawn, Sitka area, 2015.

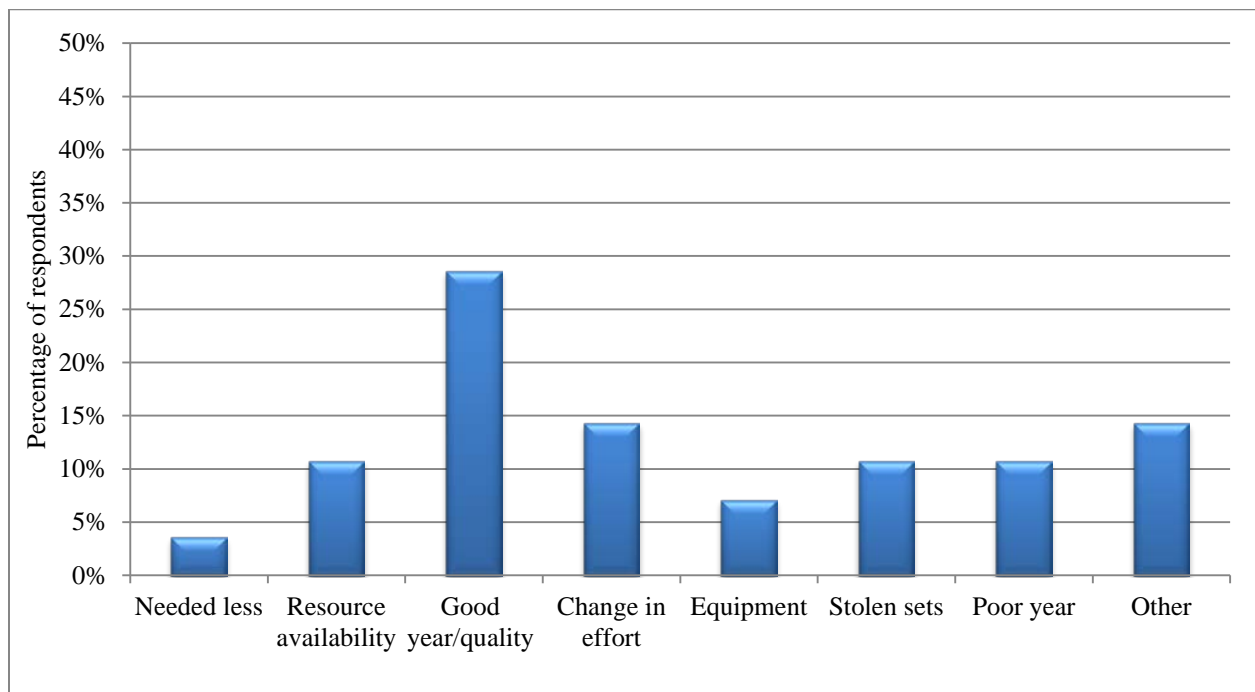


Figure 5.—Reasons given for why household harvests were different, either less or more, in 2015 than in recent years, Sitka Sound harvesters, 2015.

## CONVERSION FACTORS

Researchers found that there was a slight decrease in weight between primarily processed (from tote to wetlock box) and secondarily processed (from box to bag) weights due to the removal of branches during processing. This decrease has been factored into the conversion formula for 2015 (Table 4). Conversion factors were not calculated prior to 2010. In 2014 and 2015, a conversion factor was not calculated for quart-sized bags.

Table 4.–Conversion factors for 2010–2015.

Container type, spawn on branches	2015	Estimated average weight (pounds)				
		2014	2013	2012	2011	2010
Sea-Pro <sup>a</sup> large (50 lb) wetlock box	53.98	48.91	52.97	59.10	53.27	57.78
Sea-Pro <sup>a</sup> small (25 lb) wetlock box	25.64	24.68	22.78	28.50	24.88	25.50
Ziploc <sup>a</sup> gallon bag	3.68	4.12	3.94	4.43	3.87	4.07
Ziploc <sup>a</sup> quart bag	n/a	n/a	1.35	1.38	1.46	1.42

Container type, spawn on kelp	2015	2014	2013	2012	2011	2010
Ziploc <sup>a</sup> gallon bag	n/a	n/a	n/a	3.65	n/a	n/a
5-lb bucket	n/a	n/a	n/a	23.94	n/a	n/a
Sea-Pro <sup>a</sup> small (25 lb) wetlock box	n/a	n/a	16.67	n/a	n/a	n/a

*Sources* Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2015; Holen et al. (2011); and Sill and Lemons (2015).

*Note* “n/a” indicates conversion factors were not calculated for these years.

a. Product names are given because they are established standards for the State of Alaska, and for scientific completeness; they do not constitute an endorsement.

## HARVEST LOCATIONS

The final project objective was to document where the herring spawn harvest took place. The aggregate locations of harvests by all survey respondents are shown in Figure 6. The majority of the harvests occurred in the core area of Sitka Sound. As can be seen more readily in Table 5, the most important location in 2015 was South Middle Island (38% of harvesting households used location) followed by the Kasiana islands group (20%) and Magouns/Hayward Strait (10%). Effort in 2015 appeared to have concentrated in the more northerly regions of Sitka Sound as compared to previous years. These harvest locations are similar to 2013, when the majority of harvesters set in the Kasiana islands, Crow/Gagarin islands, and North Middle Island (Sill and Lemons 2014b). While 12% of households used North Middle Island, South Middle Island was more heavily used (by 32% of harvesters) in 2014 (Sill and Lemons 2015).

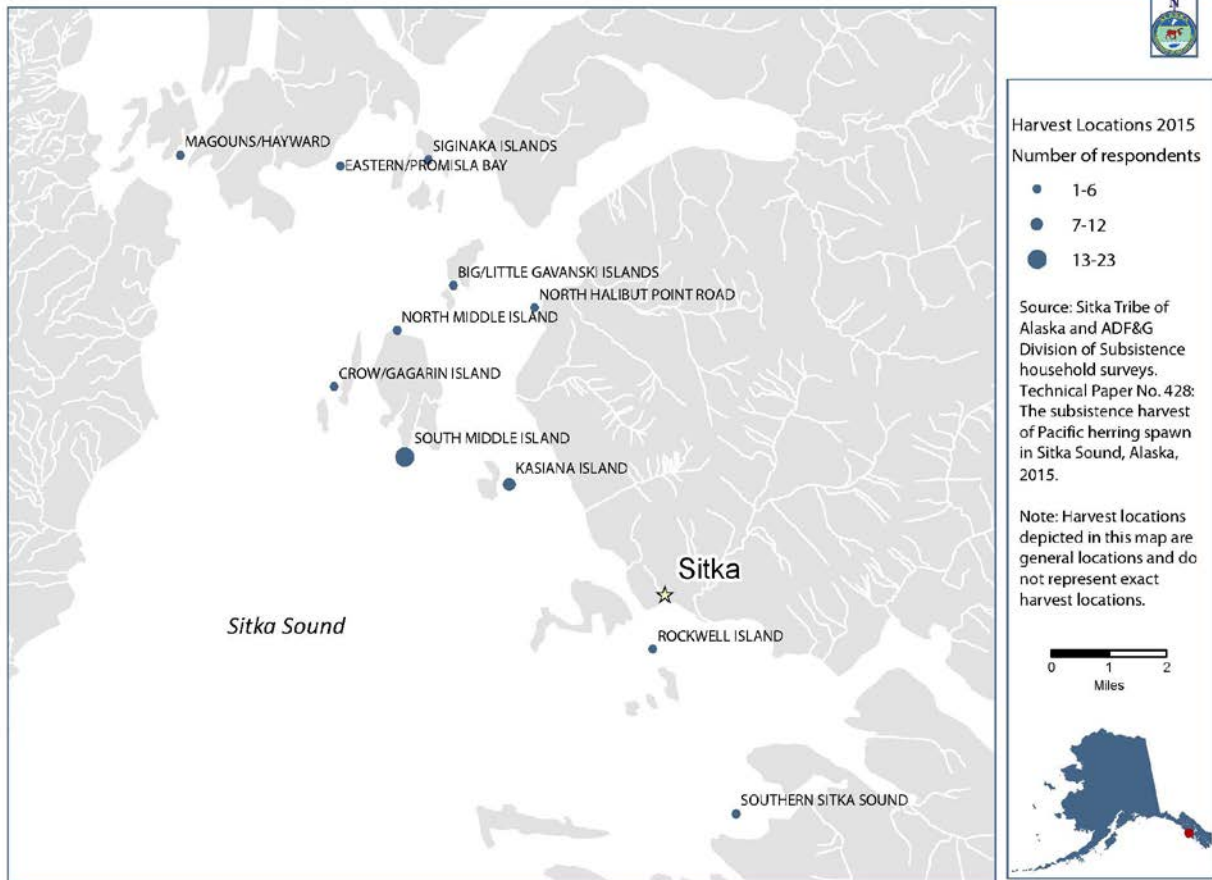


Figure 6.—Reported harvest locations, 2015.

Table 5.—Reported locations of subsistence herring spawn harvest, Sitka Sound, 2015.

Location	Reported households using each location	Percentage of harvesting households using each location
South Middle Island	23	37.7%
Kasiana Islands Group	12	19.7%
Magoun/Hayward	6	9.8%
Crow/Gagarin Islands	4	6.6%
Siginaka Islands	4	6.6%
North Halibut Point Road	4	6.6%
North Middle Island	3	4.9%
Big/Little Gavanski Islands	2	3.3%
Eastern/Promisla Bay	1	1.6%
Southern Sitka Sound	1	1.6%
Rockwell Island	1	1.6%

Source Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2015.



### 3. DISCUSSION

Over the 14 years of this harvest monitoring program, some characteristics of the Sitka Sound subsistence herring egg harvest have remained consistent. These include extensive and widespread sharing of the harvest, the use of hemlock boughs as the major substrate on which to collect herring eggs, the geographic focus of the harvest, and the main reasons harvesters give for not harvesting during any particular year. Other characteristics differ from year to year. The number of harvesters and the overall amount of the harvest are the main examples of these more volatile characteristics, as are the qualitative assessments from harvesters of the quality of the eggs. Other dynamic variables include the miles of shoreline that receive spawn, the number of consecutive days of spawn in an area, the days of the week spawning activity is present, and the weather.

Across generations and geography, the spring arrival of herring to Sitka Sound and the harvest of herring eggs are highly anticipated. Each year in Sitka, people of all ages flock to the STA offices and the dock where the SHCA boat unloads, hungry for the first taste of herring eggs. Calls come in from around the state from people looking for herring eggs to be sent to them. It is not surprising then that sharing is a key characteristic of this harvest. While over one-half of the harvesters shared herring eggs in 2015, it was the smallest percentage recorded during this project; typically, 80% to 90% of harvesters share their harvest (Table 1). It is not clear what this relatively low percentage of sharing means, especially since a similar amount of the harvest was shared (94%) in 2015 compared to previous years. The timing of the 2015 survey administration may have played a role; there was an unexpected second spawn that occurred after surveys were under way. Surveyors stopped surveying and waited until the conclusion of that second spawn, but because the survey may have been administered closer to the conclusion of the spawn than usual, respondents may not have yet shared their eggs. If the surveys had been conducted a few weeks later, more sharing may have been recorded. A few respondents indicated that this was the situation they were in, responding no to the survey question about sharing, but commenting that they were planning on doing so. Fewer households also may have shared in 2015 because they felt they did not harvest enough to share. The responses given to the question of respondents' use and harvest of herring eggs as compared to previous years indicated that harvesters' use of herring eggs was the same, but that their harvest was either more or less than in previous years (Figure 2). Over the 3 years this question has been asked, the responses appear to support the idea that a harvester's immediate needs are met first during a harvest while the remainder of the harvest, however large or small, is shared. Those harvesters that felt their harvest was less than recent years may have felt it was small enough, or their need was great enough, to not be able to share. This idea is further supported by Figure 3, which shows that more eggs were shared within Sitka than outside of town; in past years there is usually a more even split. However, those harvesters who did share their harvest did so extensively—from Tuntutuliak to Utqiagvik (Barrow) to California.

Herring eggs on hemlock branches continue to be the source of the majority of the harvest. It is the product most heavily shared with others; herring spawn on kelp and on hair seaweed tend to be reserved for the harvester's own use, though, as in 2015, some is shared every year. In terms of where harvesters go to set their branches, year after year there is a "core" area around the islands offshore from town. This area has historically been important and STA was successful in petitioning the Board of Fisheries to close part of the area to commercial herring fishing. In 2015, the majority of harvesters set their branches in this area, especially around Middle Island and Kasiana islands. The area has dependable spawn, good quality substrate, and somewhat protected waters—all factors that contribute to this area's importance for the harvest. While herring eggs can usually be found in this core area, the herring spawn throughout Sitka Sound, in different locations each year. In 2015, harvest was documented in the northern reaches of the sound, reflecting the spawning activity that occurred in the area. In 2014, by contrast, no harvest was documented in the northern part of the sound, but there was more effort concentrated in the southern part of the sound. The harvest survey does not systematically document amounts of eggs harvested from each location, so while it is seen that the majority of harvesters set branches in the core area, it is not known

where the most productive spawn occurred. It is possible that those harvesters setting in the northern areas had more productive hauls, or vice versa.

After a general increasing trend over several years, in 2015, the number of harvesters participating in the harvest was less than in 2014 (Figure 7). As in years past, one of the main reasons for not harvesting herring eggs is that the respondent was working during the harvest (33%) (Figure 4). Not all harvesters have the ability to take time off of work with little notice in order to capitalize on the spawn event. Some harvesters can predict fairly accurately when the spawn is going to happen as the time gets closer, but there is no real predictability to allow for much prior planning; the 2015 spawn began earlier than most of the previous decade. Successful harvests often require a lot of time spent on the water, watching the herring for signs that spawning is imminent. Another major reason given for not participating was that the respondent had received eggs from others (39%). As potential harvesters are presented with various challenges from work schedules, and the costs of fuel and boat maintenance, some will rely on the availability of eggs from others in the community for any given year. Everyone on the survey list has harvested within the last 3 years, so most of the harvesters who did not harvest this year will likely harvest again in the near future.

Figure 7 shows the annual variation in the number of harvesters and in the total harvest; this figure shows that there is not a direct correlation between the 2 variables. Low harvest years can have high participation, such as in 2011, or vice versa, as in 2012. In 2015, the total harvest was lower than in 2014 and fewer households participated in the harvest. The smaller number of harvesters in 2015 is likely responsible in part for the lower harvest amount because many of the successful harvesters assessed the quality of the harvest as good, commenting that if a person got to an area with good spawn, it was a good year. The lower harvest amount is also likely related to a decreased opportunity for quality spawn, because of social or ecological factors. Some of the social factors were addressed above in terms of reasons why harvesters do not participate in the harvest in a given year. Other social factors may be seen in the changing demographics of harvesters. The pattern of a small number of households harvesting a unique resource and then distributing the resource is common in Alaska's subsistence economies (Wolfe et al. 2010). These "super-households" have the time, ability, knowledge, and equipment necessary to successfully harvest subsistence resources that are then shared throughout the community. Over the past decade, a number of elder high harvesters have passed on. Some of these harvesters were also involved in the commercial fishery so they had the equipment, as well as the time and the knowledge, to participate fully. These individuals were responsible for large-scale distribution of herring eggs within Sitka Sound, as well as to outlying communities to a lesser extent. With their passing, it is not clear that younger entrants to either the subsistence or commercial fisheries are rising to take their places within the community. If ecological changes have occurred in the Sitka Sound herring population, such as shorter spawn events or less predictable herring behavior, as some respondents have indicated, these skills and knowledge become even more important. The loss of these super-households can have a detrimental effect to the entire community. Some of the activities of the former high harvesters have been taken up in a more formal manner by community harvester boats and industry-sponsored boats.

On the ecological end of the opportunity spectrum, quality of eggs can be described by the thickness of the eggs and lack of impurities, such as sand. Thickness of deposition is directly related to the number of days of spawning activity. It has been found that mean consecutive spawning days in subsistence use areas of Sitka Sound can be a reasonably good predictor of harvest success (for a further discussion of the relationship between harvest success and multi-day spawning events see both Sill and Lemons [2014a] and a thesis by James Shewmake [2013]). The ADF&G Division of Commercial Fisheries documents total days of spawning activity and the number of miles of shoreline with active spawn, but there is not an analysis of how many days of spawning activity each section of shoreline receives. In 2015, 87.9 nautical miles of spawn were recorded, the second highest mileage recorded since the department began recording spawn in 1964. On the surface, such extensive spawn deposition may seem ideal for subsistence herring

egg harvesters, but the overall number of miles of herring spawn obscures the variability at the localized areas where harvesting occurs.

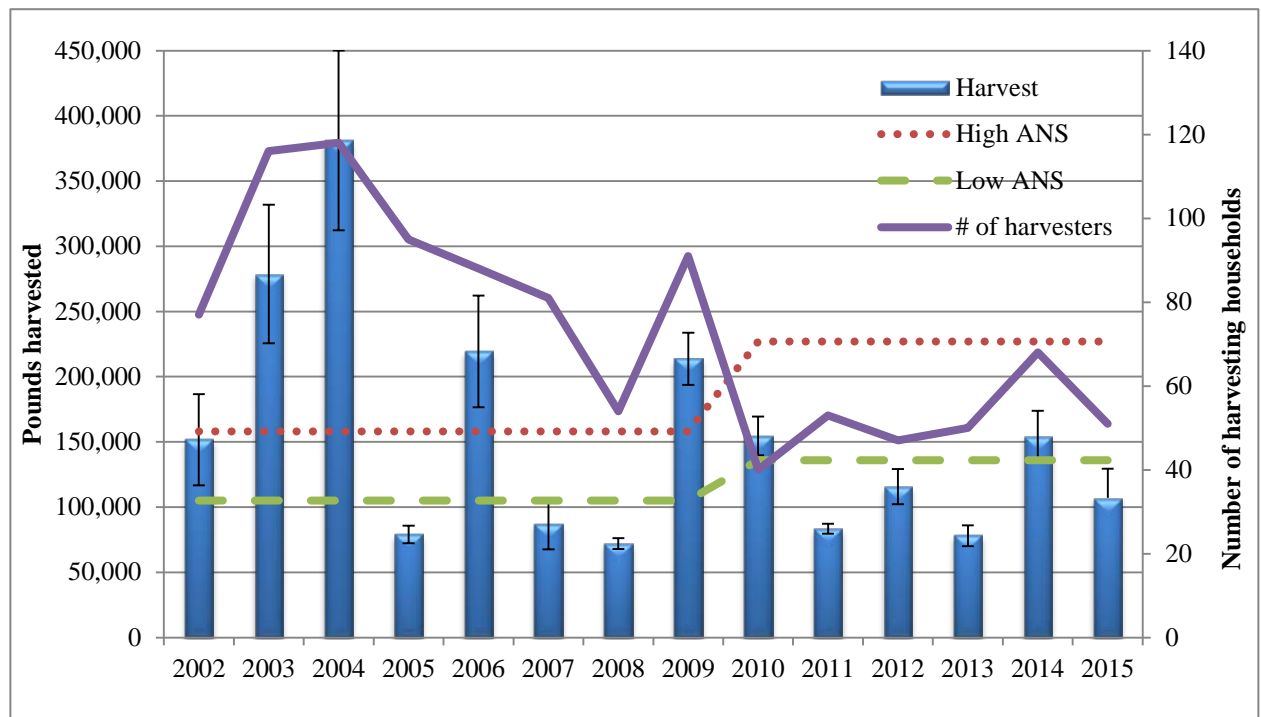


Figure 7.—Total pounds usable weight of herring spawn harvested, number of harvesting households, and amount reasonably necessary for subsistence (ANS) of herring spawn on all substrates in Sitka Sound, 2002–2015.

## CHANGES IN USE OF HERRING SPAWN

One of the limitations of this research project is that only herring egg harvesters are targeted. While that method allows for the collection of much useful information about the harvest of herring eggs, it does not allow for analysis of the wider use of herring eggs. The study had been able to document a general decrease in the participation of the subsistence herring egg harvest over the last 14 years, but there is little data available to speak to changes in overall use of the resource, either within Sitka or in other Southeast Alaska communities, or overall participation in the processing of herring eggs. In 2013, several comprehensive subsistence harvest and use studies were conducted in Southeast Alaska communities for the study year of 2012. The use of herring eggs was documented in Hydaburg, Hoonah, Haines, and Angoon; Whale Pass was surveyed, but no herring eggs were used in 2012 (Sill and Koster 2017). A comprehensive subsistence study was conducted in Sitka in 2014 for the 2013 study year. Sharing in all of these communities is widespread; the percentage of households using herring eggs on hemlock branches ranged from 15% in Haines to 77% in Hydaburg, while the percentage of households harvesting eggs on hemlock branches was much lower, ranging from 0% in Angoon to 23% in Hydaburg (Figure 8). The majority of respondents indicated that the eggs they used or harvested came from Sitka, with the exception of Hydaburg residents who also harvested and used eggs from the Craig/Klawock area (Table 6). In this limited sample of communities in Southeast Alaska, the use of herring eggs from Sitka Sound remains high, and patterns of sharing remain evident and of importance. While the harvest monitoring survey tracks participation in the harvest of herring eggs, there is no current information to show how many households are involved in the processing, distribution, or receipt of herring eggs. The survey has

shown that herring eggs continue to be widely shared and used throughout the state, but a broader survey looking specifically at the use and receipt of herring eggs from the general populace would be necessary to fully discuss changes in the use of herring eggs over time.

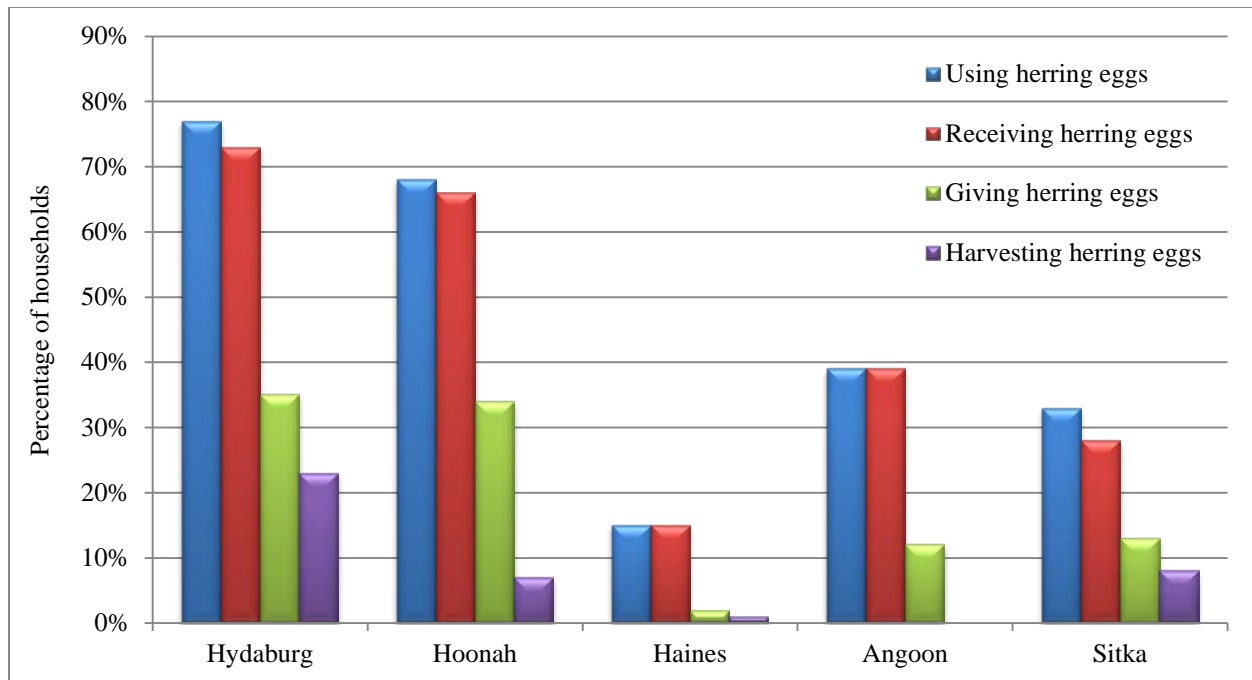


Figure 8.—Percentage of households using, receiving, giving, and harvesting herring eggs, Hydaburg, Hoonah, Haines, and Angoon, 2012; and Sitka, 2013.

Table 6.—Locations where residents reported herring eggs were sourced, Angoon, Haines, Hoonah, Hydaburg, and Whale Pass, 2012.

Source	Number and percentage of valid responses									
	Angoon		Haines		Hoonah		Hydaburg		Whale Pass	
	No.	%	No.	%	No.	%	No.	%	No.	%
Craig	0	0.0%	0	0.0%	1	1.7%	21	51.2%	0	0.0%
Haines	0	0.0%	1	8.3%	0	0.0%	0	0.0%	0	0.0%
Hoonah	0	0.0%	0	0.0%	1	1.7%	0	0.0%	0	0.0%
Sitka	20	100.0%	11	91.7%	57	96.6%	20	48.8%	0	0.0%
<b>Total</b>	<b>20</b>	<b>100.0%</b>	<b>12</b>	<b>100.0%</b>	<b>59</b>	<b>100.0%</b>	<b>41</b>	<b>100.0%</b>	<b>0</b>	<b>0.0%</b>

Source ADF&G Division of Subsistence household surveys, 2013.

Note Includes only valid responses containing a named city; households were permitted to identify multiple sources.

## CONVERSION FACTORS

Creating annual conversion factors is useful for 2 reasons.

1. Annual conversion factor summaries give researchers a more accurate estimate of herring egg harvests because individuals often report their harvest in number of boxes/bags, rather than total

pounds harvested. With an average weight determined for storage containers for that year, researchers can convert the entire reported harvest into pounds with greater accuracy.

2. The other aspect of conversion factors is their potential insight into the effect of egg density on the success of the overall harvest. From Shewmake's (2013) work, it can be seen that the number of consecutive spawning days is important to overall success. More spawning days should lead to thicker egg deposition and heavier branches. One way the project can potentially investigate egg density is through the creation of annual conversion factors.

Assuming that the herring spawn processors are relatively consistent in how they process branches for packing containers during the conversion factor updates, the average weight of a wetlock box should vary annually with spawn density—less in years with low density and more in high-density years. However, other factors such as sea water content of the set may also be affecting the weights of the processed spawn. Until more work is done to identify other factors potentially affecting the weight of wetlock boxes of processed spawn, year-to-year variations in conversion factors cannot be taken as an accurate indicator of herring spawn densities.

## **LOCATION OF HARVESTS**

The final aspect of the subsistence herring harvest that the project attempts to understand is the location of harvests. While the question concerning harvest locations has not been on the survey every year, from the years when this information was sought it is clear that there is a core area most harvesters use, but there is also year-to-year variability in all the locations used for the harvest. There are a number of reasons for this pattern. Within limits, harvesters will go where the herring are spawning. Herring do not have site fidelity like salmon; therefore, where they spawn each year can change. Harvesters look for areas they feel are most likely to produce high-quality spawn based on factors such as geography, substrate, and protection from wind and waves. Some harvesters do not have access to a boat, so they need to harvest in locations accessible by the road system, regardless of where the herring are spawning. Skiffs and other small boats are commonly used by herring harvesters and wind and rough seas can make harvesting dangerous; therefore, protected areas are sought. Protected areas are also favored for their likelihood of high-quality spawn since ocean surge can stir up sand on the seafloor, thus degrading the quality of the herring spawn harvest. As Sitka has developed, and concerns for water quality have grown, harvesters have also tried to ensure that the area they harvest from is not negatively affected by development. ADF&G documents the nautical miles of herring spawn observed in all of Sitka Sound each year. Because of the limitations in where quality subsistence harvests can occur, looking at the overall nautical miles of herring spawn in Sitka Sound does not give an accurate picture of the opportunity available to harvesters. A harvester's assessment of the length of the spawn and quality of the season is localized to areas that are accessible to that harvester and therefore may not be the same as the documented duration or total coverage of the spawn.

## **SPAWN-ON-KELP FISHERY**

In addition to further investigating the role of spawn deposition on weight conversion measurements, another aspect of the herring spawn fishery that researchers will continue to explore is the spawn-on-kelp fishery. While surveys are attempted with all harvesters of herring spawn, regardless of the substrate, herring spawn on branches accounts for the majority of the harvest and has therefore received the most attention. Often, the amounts of spawn on kelp documented by the survey have been less than that recorded on the permits (a permit is necessary to harvest spawn-on-kelp in Sitka Sound; the amount of spawn a household may harvest is not limited through this system since multiple permits may be obtained). Beginning in 2012 and continuing through 2015, researchers concentrated additional effort on identifying and contacting spawn-on-kelp harvesters. The harvest survey in 2015 estimated 2,351 lb of

spawn-on-kelp harvested (Table 3), while the preliminary permit data show a harvest of 2,458 lb.<sup>5</sup> Further study of spawn-on-kelp harvesters would be warranted to compare differences in participation to that of egg-on-branches harvesters. Comparisons of success rates and responses to annual changes in geographic spawn distribution between both sets of harvesters could also be investigated.

---

5. Preliminary data released by the Alaska Department of Fish and Game Division of Commercial Fisheries to the Division of Subsistence.

## **4. CONCLUSION**

Although participation in the subsistence harvest of herring spawn from Sitka Sound has generally dropped since the early 2000s, harvesting and sharing eggs remain important cultural activities for Southeast Alaska residents. Overall harvest amounts are influenced by the amount of harvest effort, but also by the opportunity for quality spawn in accessible locations. The herring spawn harvest continues to be shared extensively throughout Sitka, Southeast Alaska, and beyond. Concern for the resource due to the possible effect of the commercial sac roe herring harvesting activities is a consistent theme heard from harvesters. Future years of this project will continue to investigate the spawn-on-kelp harvest and comparisons with permit data for that fishery. In addition, the variations in spawn density and identifying accurate ways to track and correlate density with the harvest will be explored. Finally, a broader effort to look at overall use of herring eggs, not just the harvest effort, and changes over time, is needed but is beyond the scope of this project.

## **ACKNOWLEDGMENTS**

The ADF&G Division of Subsistence would like to thank the staff of the Sitka Tribe of Alaska for their hard work and dedication to this project; in particular we thank Jeff Feldpausch and Jessica Gill. The survey would not have been possible without their leadership and cooperation. We would like to thank the Sitka Tribe of Alaska Tribal Council and Herring Committee members for their dedication and support of the project. Within the Division of Commercial Fisheries, we appreciate the assistance and review of this project provided by Dave Gordon and Eric Coonrad. Input into the final draft of the report was gratefully received from Steve Reifensstuhl with Northern Southeast Regional Aquaculture Association and Jessica Gill with STA. There are many subsistence harvesters and commercial fishers who contributed to the success of this project by taking the time to speak to researchers and we would like to take this opportunity to thank them as well.

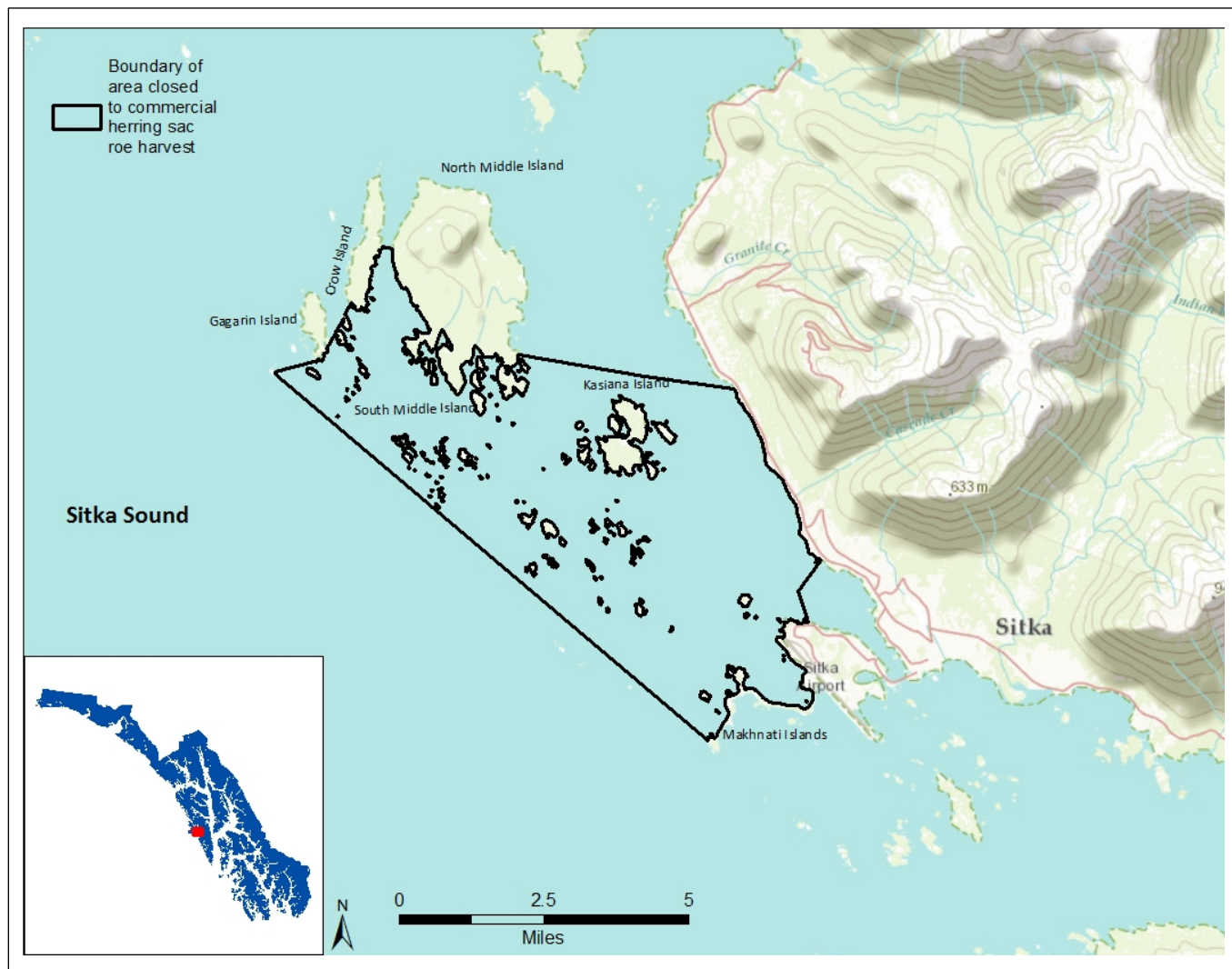


## REFERENCES CITED

- Brock, M. and M.F. Turek  
2007 *Sitka Sound subsistence herring roe fishery, 2002, 2003, and 2006*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 327: Juneau. <http://www.adfg.alaska.gov/techpap/tp327.pdf>
- Cochran, W.G.  
1977 *Sampling techniques*, 3rd edition. John Wiley & Sons: New York
- Emmons, G.T.  
1991 *The Tlingit Indians*, v. 70 book in the Anthropological papers of the American Museum of Natural History. University of Washington Press: Seattle.
- Gmelch, G. and S.B. Gmelch  
1985 *Resource use in a small Alaskan city—Sitka*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 90: Juneau. <http://www.adfg.alaska.gov/techpap/tp090.pdf>
- Holen, D., J. Stariwat, T. Lemons, V. Ciccone, and M.F. Turek  
2011 *The subsistence harvest of herring spawn in Sitka, Alaska, 2002–2010*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 343: Anchorage. <http://www.adfg.alaska.gov/techpap/TP%20343.pdf>
- Pierce, R.A.  
1972 *Alaskan shipping, 1867–1878: arrivals and departures at the Port of Sitka*, Materials for the study of Alaskan history. Limestone Press: Kingston, Ontario
- Schroeder, R.F. and M. Kookesh  
1990 *The subsistence harvest of herring eggs in Sitka Sound, 1989*. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 173. <http://www.adfg.alaska.gov/techpap/tp173.pdf>
- Shewmake, J.W.I.  
2013 *Spatial resilience and the incorporation of traditional ecological knowledge in mapping Sitka herring*. master's thesis. University of Alaska Fairbanks
- Sill, L.A. and D. Koster editors.  
2017 *The harvest and use of wild resources in Haines, Hoonah, Angoon, Whale Pass, and Hydaburg, Alaska, 2012*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 399: Douglas. <http://www.adfg.alaska.gov/techpap/TP399.pdf>
- Sill, L.A. and T. Lemons  
2012 *The subsistence harvest of herring spawn in Sitka Sound, Alaska, 2011*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 369: Juneau. <http://www.adfg.alaska.gov/techpap/TP%20369.pdf>
- 2014a *The subsistence harvest of Pacific herring spawn in Sitka Sound, Alaska, 2012*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 392: Juneau. <http://www.adfg.alaska.gov/techpap/TP392.pdf>
- 2014b *The subsistence harvest of Pacific herring spawn in Sitka Sound, Alaska, 2013*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 401: Juneau. <http://www.adfg.alaska.gov/techpap/TP401.pdf>
- 2015 *The subsistence harvest of Pacific herring spawn in Sitka Sound, Alaska, 2014*. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 408: Juneau. <http://www.adfg.alaska.gov/techpap/TP408.pdf>
- Tikhmenev, P.A.  
1978 *A history of the Russian-American Company*. University of Washington Press: Seattle

Wolfe, R.J., C.L. Scott, W.E. Simeone, C.J. Utermohle, and M.C. Pete  
2010 *The “super-household” in Alaska Native subsistence economies*. Final Report to the National Science  
Foundation, Project ARC 0352611

**APPENDIX A: MAP OF AREA OF SITKA SOUND CLOSED TO  
COMMERCIAL HERRING SAC ROE FISHING**



**APPENDIX B: SITKA SOUND SUBSISTENCE HERRING EGG  
HARVEST SURVEY, 2015**

# HERRING EGG SUBSISTENCE HARVEST SURVEY

SITKA, ALASKA

2015

This survey is used to estimate subsistence harvests of herring eggs from Sitka Sound and to describe community subsistence economies. We will publish a summary report which will be available to all households in your community. We share this information with the Sitka Tribe of Alaska, the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service and the National Park Service. We work with the Federal Regional Advisory Councils and with local Fish and Game Advisory Committees to better manage subsistence, and to implement federal and state subsistence priorities.

This project is guided by the research principles adopted by the Alaska Federation of Natives in 1993. We will NOT identify your household. We will NOT use this information for enforcement. Participation in this survey is voluntary. Even if you agree to be surveyed, you may stop at any time.

HOUSEHOLD ID:

COMMUNITY ID:

INTERVIEWER:

INTERVIEW DATE:

DATA CODED BY:

DATA ENTERED BY:

SUPERVISOR:

Sitka	313



## COOPERATING ORGANIZATIONS

RESOURCE PROTECTION DEPARTMENT  
SITKA TRIBE OF ALASKA  
429 KATLIAN STREET  
SITKA, AK 99835

907-747-7168

DIVISION OF SUBSISTENCE  
ALASKA DEPT OF FISH & GAME  
802 3RD STREET  
JUNEAU, AK 99801

907-465-3617



## HARVESTS: HERRING EGGS

HOUSEHOLD ID

How many people lived in your household in 2015?.....

Is anyone in the household enrolled in a tribe?..... Y N

If YES, which one?.....

Do members of your household USUALLY harvest HERRING EGGS for subsistence?..... Y N

In 2015...

...Did members of your household TRY TO HARVEST herring eggs?..... Y N

If NO... why not? .....

If the household tried to harvest herring eggs in 2015 fill out the rest of this page. Otherwise go to 'Assessment' section on the next page.

Please estimate how many herring eggs ALL MEMBERS OF YOUR HOUSEHOLD HARVESTED for subsistence use this year. INCLUDE herring eggs you gave away, ate fresh, lost to spoilage, or got by helping others. If fishing with others, report ONLY YOUR SHARE of the catch.

	IN 2015 DID MEMBERS OF YOUR HH...				IN 2015, HOW MANY ( ) DID YOUR HOUSEHOLD HARVEST...?		
	...USE ?	...RECEIVE	...GIVE	...TRY TO HARVEST ?	...FOR PERSONAL USE	...TO GIVE AWAY IN SITKA	...TO SHIP OUT OF SITKA
	(circle)				(amount used for each purpose)		
Herring eggs on hemlock branches	Y N	Y N	Y N	Y N			
120310000							
Herring eggs on kelp	Y N	Y N	Y N	Y N			
120306000							
Herring eggs on hair seaweed (né)	Y N	Y N	Y N	Y N			
120308000							

These columns should include all the herring eggs harvested by members of this household in 2014.

What size vessel(s) did you use to harvest herring eggs in 2015?.....

How many households do you typically harvest for?.....

If you shared with others, how many households did you share with? .....

NUMBER OF HOUSEHOLDS

COMMUNITY

NOTES: .....

.....

.....

.....

.....

.....

.....

.....

.....

OTHER FISH: 06

SITKA: 313

<b>BARTER/EXCHANGE</b>
------------------------

Do you barter or trade herring eggs?.....

If YES...

.....What is your relationship to the people you barter/trade with?

.....In what communities do they live?

.....What items have you received in exchange for herring eggs?

<b>ASSESSMENT: HERRING EGGS</b>
---------------------------------

In 2015...

Did your household use LESS, the SAME, or MORE herring eggs than in recent years?..... X L S M

If LESS or MORE, why was there a change?

Did your household get enough herring eggs?.....Y N

How do you feel your 2015 HARVEST was compared to other years?..... X L S M

If LESS or MORE, why was your harvest different?

If you HARVESTED LESS herring eggs in 2015, what was the last year you remember having a good harvest?

Do you harvest with other households?.....Y N

NOTES:

<b>COMMENTS</b>
-----------------

DO YOU HAVE ANY QUESTIONS, COMMENTS, OR CONCERNS ABOUT THE 2015 SUBSISTENCE HERRING EGG HARVEST?



**HARVESTS:**

HOUSEHOLD ID

Where did you harvest your herring eggs in 2015 - set branches, harvest seaweed, macrocystis kelp?

		# of sets...		Amount harvested	Quality (coverage, thickness)	Soak time	Comments
Location		made	harvested				
1	Kasiana Islands Group						
2	North Middle Island						
3	South Middle Island						
4	Crow/Gagarin islands						
5	Big/Little Gavanski islands						
6	Siginaka Islands						
7	North Japonski/Whiting Harbor						
8	South Japonski/Mermaid Cove						
9	Causeway Islands						
10	South Halibut Point Road						
11	North Halibut Point Road						
12	Eastern/Promisla Bay						
13	Magoons/Hayward						
14	Katlian Bay						
15	Apple/Parker Group						
16	Crescent/Jamestown Bay						
17	Southern Sitka Sound						
18	Other:						

**LOCATION****SITKA: 313**

## **APPENDIX C: 2015 CODE BOOK**

# Subsistence Herring Egg Harvest Survey 2015

Herring Spawn User Status	Code
Individual Harvester	1
Non-Harvester	2
Community Boat	3

## Page 1: Harvests

If enrolled in a tribe, which one?	Code
Sitka Tribe of Alaska	1
Organized Village of Kake	2
Metlakatla Indian Community	3
Hoonah Indian Association	4
Hydaburg Cooperative Association	5
Native Village of Savoonga	6
Angoon Community Association	7

If household did not try to harvest herring eggs in 2015, why not?	Code
Harvester – no response necessary	Blank
Did not need	1
Working during the harvest/no time	2
Received from friends/family	3
Personal or health issues	4
Other	5
Transportation/no boat	6

What size vessel did you use to harvest herring eggs?	Code
Less than 20 feet	1
20-24 feet	2
Over 24-foot pleasure cruiser	3
Commercial vessel	4
Other	5
No boat – harvested from shore	6

## Page 2: Assessments

If less or more USE, why?	Code
Harvested less	1
Needed less/needed more	2
Less effort/more effort	3
Better than last year/good year	4
Other	5

If less or more HARVEST, why?	Code
Non-harvester – no response necessary	Blank
Needed less	1
Resource availability	2
Good year/good quality eggs	3
More effort/less effort	4
No time/work	5
Equipment	6
Stolen sets	7

Poor year	8
Other	9
Do you have any additional comments about the 2015 subsistence herring egg harvest?	Code
Selling eggs a concern	1
Concerned about the future of the resource	2
Concerned about the effect of the commercial fishery on the resource	3
Odd year for spawn	4
Concerned about ADF&G management	5
Good harvest/good eggs	6
Theft of branches an issue	7
Closed area helping	8
Concerned about industry harvesting subsistence eggs	9